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PENCIL SHARPENER

FIELD OF THE INVENTION

The present invention relates generally to sharpeners for wooden pencils. In particular, the present invention relates to an electric pencil sharpener having an internal structure which simplifies assembly and provides a corresponding reduction in costs.

BACKGROUND OF THE INVENTION

Typical electric pencil sharpeners include at least a powerable electric motor, a speed reducing gear train, a multi-piece cutter assembly, a pencil size selector guide and/or a pencil alignment device, and a first switch for activating the motor, e.g. upon insertion of a pencil. Some pencil sharpeners also include a second "receptacle presence" switch for preventing operation of the motor unless a pencil shavings receptacle is mated with the housing, e.g. for safety and cleanliness purposes. These components are mounted on various internal support structures to permit precise alignment of the motor, gear train and cutter assembly, which is required for proper operation and sharpening. The internal support structures are typically

supported by a base structure. An external cover is then typically mounted to the structure to house the internal support structures and operative components. A removable receptacle is typically provided to complete the pencil sharpener apparatus. Pencil sharpeners exemplifying one or more of these characteristics are shown in U.S. Patent Nos. 2,335,148 to Hoffman, 2,545,779 to Harrison, 2,822,781 to Burton, 2,900,958 to Johnson, 3,134,365 to Hori, and 4,601,316 to Verdi.

These and other pencil sharpeners of the prior art share a common disadvantage in that they are composed of numerous parts. This results in increased costs of manufacturing the various parts and in increased costs of assembling those parts into subassemblies and to complete the pencil sharpener. Additionally, such parts and/or subassemblies are typically oddly shaped, and must be positioned and/or fastened in multiple planes or along multiple axes, which further complicates the assembly process. Such complicated assembly requires either manual assembly or complex automated machinery, both of which are expensive.

What is needed is a pencil sharpener which requires fewer, simpler parts, which allows for positioning and/or fastening of parts and/or subassemblies in fewer planes, and/or which may be quickly and easily assembled, e.g., by automated pick-and-place assembly equipment.

SUMMARY OF THE INVENTION

The present invention provides a pencil sharpener including external shells having integral internal ribs for receiving and retaining internal components of the pencil sharpener, including an electric motor, a gear assembly, and a cutter assembly. In this manner, all internal components may be placed into corresponding portions defined by the internal ribs

of an external shell. The ribs ensure proper alignment of the components relative to one another and to the shell in the x- and y-directions and temporarily, for assembly purposes, in the z-direction. All components may be placed in the shell in a single direction, e.g. in a single axial direction (e.g., the z-direction).

A second external shell is matable with the first shell. The second external shell includes complementary internal ribs for securing the components in place, e.g. in the x- and y-directions, and in cooperation with the first external shell, fixedly in the z-direction. Preferably, the first and second external shells are configured to allow mating of the second external shell with the first external shell in a single axial direction, e.g. the z-direction. Additionally, it is preferable that fasteners for securing the second external shell to the first external shell are applied in a single axial direction, e.g. the same axial direction, e.g. the z-direction. Accordingly, the components of the pencil sharpener are mounted in place upon fastening together of the first and second external shells. No internal or additional fasteners are required.

In a highly preferred embodiment, the cutter assembly includes a cutter gear module having a toothed ring gear which acts as a carrier support. In a very highly preferred embodiment, the cutter gear module houses a pencil insertion switch and a receptacle presence switch. In one such embodiment, a dual switch mechanism incorporated into the cutter gear module prevents operation of the electric motor unless the pencil is inserted and the receptacle is mated with the first and second external shells.

DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of an exemplary receptacle and exemplary first and second external shells in accordance with one embodiment of the present invention, showing internal ribs;

Figure 2A is a perspective view of the first external shell of Figure 1, showing pencil sharpener components, including a cutter gear module in accordance with one embodiment of the present invention, positioned within the shell;

Figure 2B is a perspective view of the shells, receptacle and components of Figure 2A;

Figure 3 is a perspective view of an exemplary cutter assembly of Figure 2A;

Figure 4A is a front view of the cutter gear module of Figure 2A;

Figure 4B is a rear view of the cutter gear module of Figure 2A, showing a ring gear component;

Figure 4C is rear view of the cutter gear module of Figure 4, showing the ring gear component removed;

Figure 5A is an exploded view of the mating of the cutter assembly of Figure 2A and the cutter gear module of Figure 4B;

Figure 5B is a perspective view of the cutter assembly of Figure 2A mated with the cutter gear module of Figure 4B;

Figure 6 is a front view of a pencil sharpener showing mating of the shells, receptacle and components of Figure 2B;

Figure 7 is a right side elevational view of the pencil sharpener of Figure 6;

Figure 8 is a left side elevational view of the pencil sharpener of Figure 6;

Figure 9 is a perspective view showing rear and top sides of the pencil sharpener of Figure 6; and

Figure 10 is a bottom side elevational view of the pencil sharpener of Figure 6.

DETAILED DESCRIPTION

Figure 1 is a perspective view of an exemplary receptacle 10 and exemplary first and second external shells 20, 30 in accordance with one embodiment of the present invention. The receptacle 10 is configured to be removably matable with the first and second external shells 20, 30 for receiving pencil shavings discharged from a sharpening sub-assembly of the pencil sharpener. As shown in Figure 1, first external shell 20 has internal ribs, e.g. 24, defining a first plurality of support surfaces, e.g. 24a, 24b, 24c. The support surfaces are preferably open surfaces, e.g., a semi-circle, a semi-square, a semi-rectangle, or other open shape, as discussed below. Similarly, second external shell 30 has internal ribs, e.g. 34, defining a second plurality of support surfaces, e.g. 34a, 34b, 34c. The first and second pluralities of support surfaces are complementary are therefore capable of cooperating to fixedly retain the internal components in a predefined x, y, z spatial relationship when the external shells 20, 30 and mated.

Second external shell 30 is matable with the first external shell 20 to define a substantially closed compartment. For this purpose, first and second external shells 20, 30 have interengageable mating surfaces 22, 32, interlockable tab means 26, 36, and complementary fastener bosses 28, 38. In a preferred embodiment, the receptacle 10 and first and second external shells 20, 30 are formed of a suitable plastic by injection molding to integrally form the internal ribs. In this manner, the base structure, multiple internal support

structures and external cover of the pencil sharpener, traditionally separate parts as known in the prior art, are all integrated into two external shells 20, 30. This reduces manufacturing and assembly costs.

Advantageously, the support surfaces of a single shell, e.g. first external shell 20, acts as a template for assembling components of the pencil sharpener, and the support surfaces 24 act as cradles to position and temporarily retain the components during assembly. When the support surfaces are open surfaces, all components of the pencil sharpener may be quickly and easily inserted into a shell in a single direction, e.g. the z-direction, e.g. by automated pick-and-place assembly robots. The support surfaces are formed relative to the shells and to one another to ensure proper positioning and alignment of the various components, in the x-, y- and z-directions. Because the external shells have complementary support surfaces, the first and second pluralities of support surfaces can serve as the sole means of mounting the components in place in the compartment formed by the shells. This simplifies the assembly process by eliminating assembly steps, e.g. fastening individual parts or sub-assemblies to a shell. This reduces manufacturing and assembly costs and simplifies assembly.

Figure 2A is a perspective view of the first external shell 20 of Figure 1, showing pencil sharpener components placed within first external shell 20 and supported by support surfaces, e.g. 24a, 24d, 24e of the internal ribs 24. As shown in Figure 2A, exemplary pencil sharpener components include a sharpening sub-assembly 40, a speed-reducing gear train 90, a self-contained electric motor 94 for driving the sharpening sub-assembly 40, and a power cord connector 98. Complementary internal ribs 34 and support surfaces, e.g. 34f, 34g, of second external shell 30 are shown in Figure 2B.

In the example of Figure 2A, the sharpening sub-assembly 40 includes a cutter assembly 50 and a cutter gear module 70, as discussed in detail below with reference to Figures 3-5B. However, the sharpening sub-assembly 40 may include comparable components with various different structures.

Figure 3 is a perspective view of an exemplary cutter assembly 50 of Figure 2A. As shown in Figure 3, cutter assembly 50 includes a blade-supporting shaft 52 and a rotary blade 54 and pinion 56 carried co-axially on the shaft 52. In one embodiment, the blade and pinion are fixedly mounted on a rotatable shaft. In an alternate embodiment, the blade is fixedly mounted to the pinion and both are rotatably mounted on a fixed shaft. The rotary blade 54 has spiral cutting edges 58. The cutter assembly 50 also includes a blade holder 60 defining a cavity, e.g., a conical cavity (not shown), for receiving an end of a pencil (not shown) therein and supporting the shaft 52. The blade holder 62 defines a ring flange 64. A drive shaft 62 engages the blade holder 60 for driving the blade holder 60 of the cutter assembly 50, as best shown in Figure 2A.

Efficient assembly of a pencil sharpener having external shells with complementary internal ribs is greatly enhanced by use of a cutter gear module 70 in accordance with the present invention. Figures 4A and 4B are front and rear views of the cutter gear module 70 of Figure 2A. As shown in Figures 4A and 4B, the cutter gear module 70 defines a pencil-receiving opening 72 and includes an annular ring gear 74 for meshing with the pinion 56 of the cutter assembly 50. The cutter gear module 70 defines a ring groove 76 for registering with the ring flange 64 of the cutter assembly 50. In this manner, the blade holder 50 is rotatably supported by the gear module 70 when the ring flange 64 is positioned within the ring groove 76 when the cutter assembly 50 and cutter gear module 70 are mated, as shown

in Figures 5A and 5B. The integration of several components of the prior art into the inventure cutter gear module simplifies assembly, reduces manufacturing ans assembly costs, and permits assembly by axial placement in an external shell.

The cutter assembly 50 and cutter gear module 70 are properly mated by placing the cutter assembly 50 and cutter gear module 70 in contact with corresponding support surfaces of at least one of the external shells 20, 30. After the external shells are mated, the blade holder 60 is supported by the first and second external shells 20, 30 to be rotatable around an axis of the cavity, as shown in Figure 2A. The blade holder 60 and cutter assembly 50 are operatively coupled to electric motor 94 by the speed-reducing gear train 90, as shown in Figure 2A. Accordingly, when the electric motor 94 is powered, the electric motor 94 causes the drive shaft 62 to rotate and thereby drives the blade holder 60 around the cavity, causing the pinion 56 to travel along the annular ring gear 74 and the rotary blade 54 to rotate and sharpen any pencil in the cavity, as discussed further below.

Figure 4C is rear view of the cutter gear module of Figure 4, showing the annular ring gear 74 removed. The cutter gear module 70 is a self-contained unit incorporating the annular ring gear and one or more switches, and is capable of mounting in a shell by placement in a single direction, e.g., in the z-direction. The exemplary cutter gear module 70 shown in Figure 4C houses a pencil insertion switch and a receptacle presence switch in the form of a dual switch.

As shown in Figure 4C, the dual switch 80 includes a first electrically conductive contact 82 electrically connected to a first side of a circuit powering the electric motor 94 and a second electrically conductive contact 84 electrically connected to a second side of a circuit powering the electric motor 94. The first and second contacts 82, 84 are mounted to the

cutter gear module 70. A third contact 86 is mounted to the cutter gear module 70 in spaced relationship to said first and second contacts 82, 84. A first pawl 87 is mounted on the cutter gear module 70 in position to cause the third contact 86 to electrically connect with the first contact 82 responsive to insertion of a pencil into the pencil-receiving opening 72. A second pawl 88 is mounted on the cutter gear module 70 in position to cause the third contact 86 to electrically connect with the second blade 84 responsive to mating of a receptacle 10 with the first and second external shells 20, 30.

Accordingly, the dual switch 80 is operatively connected to the electric motor 94 for driving the sharpening sub-assembly 40 only when the dual switch 80 is activated by inserting a pencil into the pencil-receiving opening 72 and mating a receptacle 10 with the first and second external shells 20, 30. In other words, the dual switch 80 will cause the electric motor 94 to drive the sharpening sub-assembly 40 only when the first pawl 87 is engaged by a pencil to cause the first and third contacts 82,86 to electronically connect, and the second pawl 88 is engaged by the receptacle to cause the second and third contacts 84, 86 to contact, thereby closing the circuit. The exemplary receptacle 10 is provided with an internal fin 12 for contacting the second pawl 88 of the dual switch 80, as shown in Figures 1 and Figures 4A - 4C.

After all the components are placed in the first shell 20, as shown in Figure 2A, the second external shell 30 is placed over the first external shell 20, causing interengagement of mating surfaces 22, 32 and interlocking of tab means 26, 36. Due to the design of the support surfaces, 24, 34, this may be performed by advancing the second shell in the same direction (z-direction) used for placement of the components, which is particularly suitable for automated pick-and-place robotic assembly, resulting in lower assembly costs. Finally,

screws or other fasteners are driven through complementary fastener bosses 28, 38 to lock the external shells together, and thereby fixedly retain the internal components within the compartment formed by the shells. Advantageously, the fasteners may be advanced in the same z-direction, and therefore may be completed by an automated assembly process.

Thus, the pencil sharpener may be quickly and easily assembled e.g., in an automated fashion, from relatively few, simple components, resulting in significant savings of manufacturing and assembly costs.

Figures 6 - 10 show right, left rear, top and bottom side views of the pencil sharpener 100 after mating of components shown in Figure 2B.

The exemplary pencil sharpener 100 of Figures 6-10 can be readied for use by connecting the pencil sharpener to a suitable power supply and mating the receptacle 10 with the first and second external shells 20, 30, as shown in Figures 6 -10. The internal fin 12 of receptacle 10 causes second pawl 88 to pivot and close second and third contacts 84, 86. However, the circuit powering the motor 94 is not yet closed and so the pencil sharpener is still inoperable, which is advantageous for safety purposes to prevent injury by accidental contact with an operating rotary blade. The pencil sharpener 100 may then be operated by inserting a pencil through the external shells 20, 30 and into the pencil receiving opening 72 of the cutter gear module 70. This causes first pawl 87 to pivot and close first and third contacts 82, 86. This closes the circuit powering the motor 94 and causes the motor to operate, thereby driving the gear train 90, and causing cutter assembly 50 to rotate on the drive shaft 62. This rotation causes pinion 56 to travel around annular ring gear 74, thereby causing the rotary blade 54 to rotate and sharpen the pencil. Sharpening continues until the pencil is removed from the pencil receiving opening 72, at which time pawl 87 pivots to open

the power circuit, and the motor 94 stops running. Similarly, the circuit is opened when receptacle 10 is removed from the external shells 20, 30.

Having thus described particular embodiments of the invention, various alterations, modifications, and improvements will readily occur to those skilled in the art. Such alterations, modifications and improvements as are made obvious by this disclosure are intended to be part of this description though not expressly stated herein, and are intended to be within the spirit and scope of the invention. Accordingly, the foregoing description is by way of example only, and not limiting. The invention is limited only as defined in the following claims and equivalents thereto.